In-camera cropping to standard photo sizes

FIELD OF THE INVENTION

The present invention relates generally to photography.

BACKGROUND OF THE INVENTION

A common difficulty in photography arises from the fact that the aspect ratio, the ratio of width to height, of the image area of a camera typically does not match the aspect ratios of several common photographic print formats. For example, the image area of a 35 millimeter film camera is 36 millimeters wide and 24 millimeters high, giving an aspect ration of 36:24, or 1.5:1. Some digital cameras also have an image area aspect ratio of 1.5:1. An 8 X 10 inch print, however, has an aspect ratio of 10:8, or only 1.25:1. When a photograph taken with a camera whose aspect ratio is 1.5:1 is printed on 8 X 10 inch paper stock, one sixth of the image is typically omitted because the camera's image area enlarged to 8 inches tall would be 12 inches wide.

Most casual photographers have their photographic printing done by commercial printing labs that are highly automated, and give the photographer little control over how the photographs are printed. In the above example, the photographer may have no way to specify which one sixth of the available image will be omitted so that the remainder can fit on 8 X 10 inch print stock, and may be disappointed with the choice made by the automated printing lab.

Existing ways to avoid this problem are unsatisfactory. In some cases, the photographer could choose a standard print format with the same aspect ratio as the camera. For example, 4 X 6 inch prints would match photographs taken with a camera whose aspect ratio is 1.5:1. However, this would typically limit the

photographer to one print size, and may not even be possible. For example, many digital cameras use an aspect ratio of 4:3, which does not match any standard print format.

The photographer could compose all of his photographs to include a larger field of view that is actually needed, and then use digital imaging equipment to crop the photographs to the desired aspect ratio later. However, this requires the photographer to remember to alter his composition, requires extensive and often tedious manual intervention, and may compromise the resolution of the photographs.

A few digital cameras allow the photographer to choose between a 3:2 aspect ratio and a 4:3 aspect ratio, but these choices still do not match may common uses of photographs.

Some photographic printing labs and some home digital photography software allow the full image area to be printed on paper of any standard size, scaling the photograph to fit on the paper in the most restrictive dimension, and simply leaving an unprinted band on the edges of the paper in the other dimension. However, the resulting prints, typically having white stripes on one or two edges, are unusual and may be objectionable.

What is needed is a convenient way to give the photographer more control over the printed composition of a photograph in a standard print format.

SUMMARY OF THE INVENTION

A digital camera allows the photographer to specify an aspect ratio at which a photograph will be used, typically an aspect ratio of a standard photographic print format. The aspect ratio may optionally be specified by indicating which standard format is to be used. The aspect ratio may optionally be specified by a numerical

value. The camera may optionally alter its preview image to match the desired aspect ratio. The resulting photograph may optionally be cropped to the desired aspect ratio before being stored. The resulting photograph may optionally be stored in its uncropped size, and aspect ratio and cropping information stored with it as metadata.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a simplified block diagram of a digital camera.

Figure 2 shows a digital camera in a typical example mode of use.

Figure 3 shows a digital camera being configured, through its user controls, in accordance with an example embodiment of the invention

Figure 4A depicts the camera in a preview mode in accordance with an example embodiment of the invention.

Figure 4B depicts the camera in a second preview mode in accordance with an example embodiment of the invention.

Figure 4C depicts the camera in a third preview mode in accordance with an example embodiment of the invention.

Figure 5 depicts a digital camera in accordance with another example embodiment of the invention.

Figure 6 shows a camera that has been placed in a mode for selecting an arbitrary aspect ratio.

Figure 7 illustrates a camera connected to an external device for configuration.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 depicts a simplified block diagram of a digital camera. A lens **101** gathers light from a scene (not shown). The lens redirects the light so that the

redirected light **102** forms an image of the scene on an electronic array light sensor **103**. Electronic array light sensor **103** may be a charge-coupled device (CCD) sensor, an active pixel complementary metal oxide semiconductor (CMOS) sensor, or another kind of sensor. Image data **104** from electronic array light sensor **103** is transmitted to a logic unit **110**. The logic unit may comprise a microprocessor, a digital signal processor, one or more application specific integrate circuits (ASICs), or some combination of these, and controls the operation of electronic array light sensor **103** using control signals **105**. Logic unit **110** may also control the operation of lens **101** using control signals **113**. Logic unit **110** may also process digital photographs in various ways, including applying image compression techniques to them. The camera may comprise a strobe **106** for supplying light **107** to the scene. Strobe **106** may be controlled by strobe electronics **108**, which are in turn controlled by logic unit **110**.

The camera also comprises storage **111**, which may include nonvolatile memory for relatively long term storage of digital photographs taken by the camera. Some or all of the storage may be incorporated as part of logic unit **110**. For example, the logic unit may comprise some flash memory, which is a form of nonvolatile re-writable semiconductor memory. Storage **111** may also comprise other kinds of memory such as random access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), or other kinds of memory. Logic unit **110** may use memory, including some of storage **111**, to hold intermediate computational results, executable microprocessor instructions, configuration information, or the like. At least a portion of storage **111** is used for relatively long term storage of digital photographs.

A digital photograph is a set of numerical values corresponding to locations in the scene being photographed. Typically the numerical values record the brightness

of the corresponding scene locations, and may also record color information. A file holding a digital photograph typically includes header information describing the size of the image, the data format of the numerical values, and other descriptive information. The image data in the digital photograph may be compressed, either with some loss of image information or losslessly, so that storage memory is conserved. The term digital photograph may also refer to the file holding a digital photograph. A digital photograph may also sometimes be referred to as simply a "photograph".

The camera also comprises a display **109**, which may be used for various purposes. Display **109** is typically a liquid crystal display, but may be a viewfinder microdisplay, or another kind of display. Display **109** may be used in a preview mode, whereby the camera repetitively displays its rendition of the scene to aid the photographer in composing a photograph. Display **109** may also be used to review photographs for quality and composition. Display **109** may also be used in conjunction with user controls **112** to aid the photographer in controlling the function of the camera. For example, a selection of choices may be shown on display **109**, and the user may select from the choices using user controls **112**. User controls **112** may comprise buttons, dials, switches, touchpads, or other input devices.

Figure 2 shows a digital camera **200** in a typical example mode of use. During composition of a photograph, camera **200** repetitively displays, on display **109**, a preview image of the scene to be photographed. Each preview image is a transitory digital photograph of the scene encompassed by the camera's field of view. These preview images assist the photographer in composing a "final" photograph, and may also be used by the camera logic **110** to evaluate the exposure level required for a pleasing photograph, to assist in focusing the lens **101**, or for other purposes. The

preview images are typically not stored by the camera beyond the time needed for their display and for any analysis done by camera logic **110**. When the photographer is satisfied with the composition, he can cause the camera to take a final photograph by fully actuating shutter release button **201**. The camera may perform other automatic functions during the time between the full actuation of the shutter release button **201** and the taking of the final photograph. A final photograph, in contrast to the preview images repeatedly taken earlier, is stored in the camera's storage **111** where it is available for later retrieval. The final photograph typically stays in storage **111** until it is affirmatively deleted by the user.

Figure 3 shows digital camera **200** being configured, through its user controls, in accordance with an example embodiment of the invention. In Figure 3, camera logic **110** has displayed on display **109** a menu of choices. The photographer can select from the menu of choices using a user control such as example control **302**. Example control **302** is an edge drive jog encoder, available from the Matsushita Electric Corporation of America in Secaucus, New Jersey, and allows the photographer to interact with logic **110** in navigating the user interface of camera **200**. One of skill in the art will recognize that other kinds of controls and user interface presentations may be used within the scope of the attached claims.

In Figure 3, by way of example, the photographer has indicated that he wishes to take photographs with an aspect ratio compatible with the 8 X 10 inch print format, which has an aspect ratio of 1.25:1. Once this preference is communicated to the camera, the camera stores it for use during the taking of future photographs.

Table 1 lists some standard photographic prints and their nominal aspect ratios. The actual dimensions of a photographic print may vary somewhat due to manufacturing tolerances.

Table 1. Standard Photographic Print Formats

Standard Format (Dimensions in inches)	Aspect Ratio (Width/height)
3.5 X 5	1.43
4 X 6	1.50
5 X 7	1.40
8 X 10	1.25
11 X 14	1.27

Figure 4A depicts the camera in a preview mode in accordance with an example embodiment of the invention. In Figure 4A, the camera, under the control of logic **110**, has displayed the preview image on display **109** with a portion indicated to be outside the specified aspect ratio. The term "outside the specified aspect ratio", for the purposes of this disclosure, refers to portions of a photograph that would be removed in the process of cropping the photograph to the specified aspect ratio, while leaving one dimension, either length or height, of the photograph unchanged. In Figure 4A, the camera has "grayed out" enough of the preview image that the remaining portion has an aspect ratio of 1.25:1. Graying out of a portion of a display is a common user interface technique in which a part of the display is presented with reduced image contrast. Because the example camera sensor and display **109** have an aspect ratio of 1.5:1, the portion of the preview image that is grayed out is at the ends of display **109**. The display in Figure 4A reveals that when the impending photograph is printed as an 8 X 10 inch print, its composition may not be as pleasing as might have appeared had the whole display **109** been considered in composing the photograph. This advance indication gives the photographer an opportunity to re-compose the photograph to a composition suited to the intended print format.

The graying out of the image area that is outside the requested aspect ratio is but one way the indication might be accomplished. The area outside the requested aspect ratio may be blacked out in the preview display, as shown in Figure 4B, or a set of lines **401** could be drawn on the preview image indicating the limits of the requested aspect ratio, as shown in Figure 4C, or some other technique could be used. The aspect ratio indication in Figure 4A shows the desired image area centered in the preview image shown on display **109**. Alternatively, all of the excluded area could be taken from one side of the preview image, or some intermediate location may be chosen.

Once the photographer has taken a final photograph, the camera may proceed in one of several ways.

In one example embodiment, the camera crops the final photograph to the aspect ratio specified, and stores the cropped photograph. Cropping is the process of removing portions of the photograph, typically along one or more edges, to reduce the size of the photograph. Cropping can change the aspect ratio of a photograph when only the length or only the width of the photograph is cropped, or when the length and width of the photograph are cropped in different proportions. In a digital camera in accordance with an example embodiment of the invention, logic unit **110** performs cropping by rearranging the digital values of the digital photograph in storage area **111**.

For example, a typical 6 megapixel electronic array sensor produces images in its native resolution that are 3000 pixels wide and 2000 pixels high, resulting in an aspect ratio of 1.5:1. A camera in accordance with an example embodiment of the invention that has been instructed that the user wishes an aspect ratio compatible with the 8 X 10 inch print format may discard some pixels on the left or right edge, or both

left and right edges, of a digital photograph to produce a resulting digital photograph that is 2500 pixels wide and 2000 pixels high, thus having an aspect ratio of 1.25:1. This resulting cropped digital photograph may then be stored, excluding the discarded pixels.

Many digital cameras provide camera options for producing photographs that encompass the camera's entire field of view, but are rendered at a lower resolution than the native format of the camera's sensor. For example, a camera using the 6 megapixel sensor described above may allow users to produce photographs in various reduced resolutions, such as 1500 by 1000 pixels, in order to conserve storage space. The selective cropping to achieve an aspect ratio compatible with a standard print format may be applied to these reduced resolution photographs as well.

In another example embodiment, the camera stores a digital photograph that includes the entire area of the camera's sensor (whether in full resolution or a reduced resolution as described above), but also stores the photographer's indication of the desired aspect ratio as metadata in the digital photograph file. For example, using a camera with the 6 megapixel sensor described above and assuming full resolution, if the photographer has indicated that he wishes an aspect ratio compatible with an 8 X 10 inch print format, the camera stores the entire 3000 X 2000 pixel photograph, but also records the photographer's indication that a portion of the photograph 2500 X 2000 pixels may be selected for producing an 8 X 10 inch print. By way of example, this indication may be stored in a comment or "APP" segment of a JPEG file, or may be stored as tag data in a TIFF file. Pending U.S. patent application number 10/686,081, entitled "System and method to allow undoing of certain digital image modifications" and having a common assignee with the present application, describes how to store metadata in these file formats, and is hereby incorporated for all that it

discloses. Storing the entire available image preserves image information that would otherwise be discarded, and may allow the photographer to select other print formats at a later time.

In yet another example embodiment, the camera stores a digital photograph that includes the entire area of the camera's sensor (whether in full resolution or a reduced resolution as described previously), and then provides an in-camera cropping function that allows the photographer to crop the photograph, using the camera's user controls, so that the resulting cropped photograph is compatible with a standard print format.

Figure 5 depicts a digital camera in accordance with this example embodiment of the invention. In Figure 5, the camera has been placed in an in-camera cropping mode. The display indicates that the camera has been previously instructed that photographs will be cropped to an aspect ratio compatible with the 5 X 7 inch print format. A selection rectangle **501** is imposed on a representation of the scene **502** previously photographed. Several camera controls work in concert to accomplish the cropping. A four-way rocker switch **503** allows the user to move the selection rectangle around the scene representation by depressing the rocker switch at any of its four directional arrow markings. Edge drive jog encoder **504** allows the user to enlarge or reduce the size of the selection rectangle, creating an effect similar to the action of a digital zoom feature. Button **505** allows the user to effect the cropping and save the resulting cropped digital photograph. Button **506** allows cancellation of the crop operation, leaving the stored photograph unchanged. Button **507** may scroll through different aspect ratio choices, causing the camera to change the aspect ratio of selection rectangle **501** in response.

This example combination of controls allows the camera user to crop a previously taken photograph to an aspect ratio compatible with any supported print format, and to select what portion of the photograph is used to fill the selection rectangle. The camera user can conveniently choose the aspect ratio that is compatible by selecting the print format by its common designation.

As in the earlier example embodiments, the camera may store only the cropped image, or may store the entire original image with the cropping information stored as metadata. The cropping function can work equally well with full resolution photographs, as well as those taken with space-saving reduced resolution. Multiple versions of the photograph could be stored with different aspect ratios, or a full resolution image could be stored with more than one set of metadata cropping information

In still another example embodiment, the camera user can select a custom or arbitrary aspect ratio. Figure 6 shows an example user interface arrangement for this function. In Figure 6, the camera has been placed in a mode for selecting an arbitrary aspect ratio. Display **109** shows a rectangle having the aspect ratio currently selected (2.00 : 1 in the example display). The camera user can use rocker switch **503** to increment or decrement the currently specified aspect ratio. For example, pressing the upward-pointing arrow portion of rocker switch **503** may cause the selected aspect ratio to increase by 0.01 units, and the camera my redraw the rectangle to illustrate the appearance of the selected ratio. Buttons **505** and **506** allow the user to save the current selection, or cancel the changes that may have been indicated.

In this way, the camera user can select an aspect ratio by its numerical value. Of course, the user could select a numerical value that corresponds to a standard photographic print format. For example, the user could select an aspect ratio of

1.43:1, which corresponds very closely to the standard print format of 3.5 X 5 inches. A camera user could select an aspect ratio of 1:1, indicating a square photographic format, or even an aspect ratio in which the width is less than the height.

In a variation of this example embodiment, the user can select an arbitrary aspect ratio by selecting an arbitrary width and an arbitrary height for the desired photograph. The camera can then compute the resulting aspect ratio, or simply use the specified width and height to compute the appropriate cropping boundaries. The width and height may be specified in inches, centimeters, or another appropriate unit of measure.

Once the custom aspect ratio has been communicated to the camera, it may be used by the camera as previously described. The camera may alter its preview mode display to allow the photographer to compose photographs using a display of only the portions of the scene within the selected aspect ratio. The resulting final photograph may be cropped to the selected aspect ratio before being stored, or the cropping information may be stored as metadata with a stored photograph that includes the entire area of the camera's sensor. The selected aspect ratio may be applied to a full-resolution photograph, or a reduced-resolution photograph.

As an alternative to using camera user controls to select an aspect ratio, at least a portion of the camera user interface may be presented on a computer or other device external to the camera. Figure 7 illustrates this arrangement. In this arrangement, the user uses the external device **700** to choose an aspect ratio at which the camera should produce photographs, and then the selected aspect ratio is communicated to the camera by way of a communication link **701**. The communication link may be a USB interface, an optical link, a wireless link, or another kind of communication link. This arrangement has the advantage of letting

the camera user configure a large number of camera settings, including an aspect ratio, using the larger and more convenient display of the external computer or other device.

The foregoing description of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.